Trends and Patterns of Mortality Associated with Birth Defects and Genetic Diseases in the United States, 1979-1992: An Analysis of Multiple-Cause Mortality Data

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Abstract

Contemporary information on the trends and patterns of mortality associated with birth defects and genetic diseases is lacking in the United States. To study these trends and patterns, we used Multiple-Cause Mortality Files (NCHS). From 1979 through to 1992, 320,208 deaths in the United States were associated with birth defects and genetic diseases. The age-adjusted mortality rates for people with birth defects declined from about 8.2 per 100,000 in 1979 to about 6.7 per 100,000 in 1992 and the mortality rates for people with genetic diseases increased from 2.2 per 100,000 in 1979 to 2.5 per 100,000 in 1992. The mortality rate was higher among men than among women and higher among blacks than among whites or other races for both birth defects and genetic diseases associated deaths. The rate among infants with birth defects was more than 25 times higher than those among other age groups. About half of the children whose deaths were associated with birth defects had cardiovascular system defects, 15% had central nervous system defects, and 12% had chromosomal defects. For deaths associated with genetic diseases, hereditary neurologic or storage disorders were the most common genetic diseases (38%), followed by metabolic disorders (21%), sickle cell and thalassemia (12%). The decline in the rate of mortality from birth defects in the United States probably reflects improvements in medical and surgical care and other factors. Most of the mortality associated with birth defects remains in the pediatric age group (less than 15 years old). The upward trend we detected for the deaths with genetic diseases was most likely related to improved recognition and reporting of some genetic diseases rather than to the increased prevalence.

Introduction

In the United States, birth defects are the leading cause of infant mortality as well as the leading cause of years of potential life lost before age 65 (YPLL) [Shapiro et al., 1965; Centers for Disease Control, 1986; Monthly Vital Statistics Report, 1988; Centers for Disease Control, 1990; Lynberg et al., 1990; Kalter et al., 1991]. Yet there is no contemporary information available on trends and patterns of birth defect-associated mortality beyond age one or on trends and patterns of genetic disease-associated mortality not associated with structural birth defects in the United States. Because major birth defects occur in about 3% of births [Warkany et al., 1961; Kalter et al., 1983; Chavez et al., 1988], and about 5% of live-born infants are expected to have diseases with an important genetic component by age 25 [Czeizel et al., 1984; Baird et al., 1988], advances in medicine and molecular genetic technology are likely to increase the number of surviving individuals with birth defects and genetic diseases. As a result, the proportion of people with birth defects and genetic diseases is expected to increase among all age groups. In this study, we use the Multiple-Cause Mortality Files (MCMFs) of the National Center for Health Statistics (NCHS) to examine trends and patterns of mortality associated with birth defects and genetic diseases by age, sex, and racial or ethnic group in the United States from 1979 through 1992.

Methods

Since 1968, the National Center for Health Statistics (NCHS) has annually compiled data from all death certificates filed in the United States and has made these data available on its Multiple-Cause Mortality Files (MCMFs)[Israel et al., 1986]. These files include demographic and geographic information on the decedent as well as the International Classification of Disease (ICD) codes for the underlying cause of death (UCD) and up to 20 conditions listed on the death certificate (14 conditions before 1979). The International Classification of Diseases, Ninth Revision (ICD-9) was implemented in 1978, and it was in effect during the 14-year period we studied.

The MCMFs exist in two formats: entity axis and record axis. The entity axis format provides a separate code for each disease listed on the death certificate. The record axis is edited by a computerized algorithm known as the translation (TRANSAX). The Automated Classification of Medical Entities (ACME) algorithm determined the UCD from conditions and their positions as listed on the death certificates [Israel et al., 1986]. Quality assurance of the data is maintained by trained nosologists who code conditions at the state level and, in turn, by nosologists at NCHS who periodically review data from a 10% sample of the submitted death certificates.

We searched the record-axis portion of the 1979-1992 MCMFs for records containing ICD-9 codes 740.0 to 759.9 (congenital anomalies) and a few other codes outside the chapter of congenital anomalies for birth defects (ICD-9 codes are listed in Table I). We selected eight categories of genetic diseases. Although some genetic diseases require at least five digits of the ICD-9 code to be identifiable, the MCMFs used only four digits, which resulted in some cases of non-genetic diseases being included in the files. For example, ICD-9 code 279.1 (deficiency of cell-mediated immunity) has five subcategories. Three of them are genetic diseases (279.11 DiGeorge=s syndrome; 279.12 Wiskott-aldrich syndrome, and 279.13 Nezelof=s syndrome), but code 279.10, immunodeficiency with predominant T-cell defect, and code 279.19, other, are not genetic diseases. The code 279.10 is also likely to be confused with HIV infection, especially during the late 1970s and early 1980s. We excluded all such cases for which MCMFs identification was inadequate. Table I lists the ICD-9 codes of birth defects and selected genetic diseases used in this study. We included all cases for which congenital anomalies or selected genetic diseases were listed as UCD, or otherwise mentioned in the MCMFs. We defined the deaths described in those records as birth defect- and genetic disease-associated deaths and calculated the death certificate reported mortality rates. The age-adjusted annual mortality rates for such deaths in the United States were calculated as the number of deaths per 100,000 persons, based on estimates of the US resident population. We used the 1980 US population age distribution as the standard population to calculate age-adjusted rates. We used 1970, 1980, and 1990 US census data to calculate intercensal population by age, sex, and racial groups. We also calculated age-adjusted mortality rates by sex and race for death associated with birth defects and genetic diseases separately.

To examine age-specific mortality rates, we used the following age groups: less than 1 year, 1 to 4 years, 5 to 9 years, 10-14 years, 15-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, and over 65 years. To study racial differences, we used the categories of AWhite@, ABlack@, and AOther Races@ as provided in the MCMFs. We also calculated the proportion of deaths that were associated with birth defects and genetic diseases to total deaths that occurred in the United States by year, sex, and racial groups.

To study the distribution of birth defects by organ system, we divided birth defects into eight categories: central nervous system

defects/eye defects, cardiovascular system defects, cleft palate and cleft lip defects, gastrointestinal defects, genitourinary defects, musculoskeletal and limb defects, miscellaneous structural defects, and chromosomal system defects. These categories included both isolated and multiple birth defects. We also divided genetic diseases into eight categories: hereditary neurocutaneous disorders, hereditary metabolic disorders, cystic fibrosis, hereditary immunodeficiencies, nonsickling hereditary blood disorders, sickle cell and thalassemia, and hereditary neurologic or storage disorders.

Results

For 1979 through 1992, the MCMFs contain records of more than 24 million deaths, of which 320,208 were associated with birth defects and genetic diseases. Of these, 247,456 (77%) were associated with structural birth defects (ICD-9, 740.0-759.9). And of the birth defect-associated deaths, 74% had a birth defect listed on the death certificate as underlying cause of death (74% for whites, 80% for other races, and 77% for blacks), and 55% involved decedents less than 1 year old. Of the 74,856 genetic disease-associated deaths, 59% had selected genetic disorders as the underlying cause of death (58% for whites, 59% for other races, and 62% for blacks), and 6.5% involved decedents less than age 1. There were 2104 cases in which both birth defects and selected genetic diseases were mentioned on the death certificates.

Figure 1 and 2 show age-adjusted mortality rates by sex and racial or ethnic groups for deaths associated with birth defects and genetic diseases respectively. Overall, the rates for birth defects declined from about 8.2 per 100,00 in 1979 to 6.7 per 100,000 in 1992, and the rates for genetic diseases increased from about 2.2 per 100,000 in 1979 to 2.5 per 100,000 in 1992. The rates for males were higher than those for females, but the pattern of decline for birth defects and increase for genetic diseases from 1979 through 1992 was similar for males and females.

The mean age-adjusted mortality rate for birth defects among blacks (9.5 per 100,000) was about 34% greater than that among whites (7.1 per 100,000), and 56% greater than that among people of other races (6.1 per 100,000). The rates for genetic diseases among blacks (3.1 per 100,000) was about 48% greater than that among whites (2.1 per 100,000), and three times greater than that among people of other races (0.92 per 100,000). From 1979 to 1992, the mean mortality rate for birth defects among whites declined from 8.0 to 6.4 per 100,000 (25%), that among people of other races from 7.2 to 5.1 per 100,000 (41%), and that among blacks declined from 10.6 to 8.7 per 100,000 (22%). The rates for genetic diseases among whites increased from 2.0 to 2.3 per 100,000 (15%), that among people of other races from 0.8 to 1.0 per 100,000 (25%), and that among blacks declined from 3.0 to 3.6 per 100,000 (20%).

The mortality rate from birth defects for infants was more than 25 times higher than for the other age groups. The mortality rate for birth defects declined from about 260 per 100,000 among infants to about 8.3 per 100,000 among children aged 1-4 years, and 2.1 per 100,000 among children aged 5-9 years. For birth defects, the age-specific mortality rates were lowest among children aged 10-14 years (1.7 per 100,000). The mortality rate among people more than 65 years old was about the same as that for children age 1-4 (Figure 3). For genetic diseases, the rates declined from about 9.3 per 100,000 among infants to about 1.6 per 100,000 among children aged 1-4 years, and the lowest rate was observed among children aged 5-9 years old (1.0 per 100,000). The rates steadily increased among people aged 35 years or more (Figure 4). Overall, the age-specific mortality rates for birth defects were higher for males than for females. For genetic diseases, except for age group 5-9, the rates were higher for males than for females.
(Figure 3 and 4 are about here)

For birth defects, age-specific mortality rates for blacks were higher than those for whites or for people of other races, except for people over 65, among whom whites showed a slightly higher rate (8.4 per 100,000) than blacks (8.0 per 100,000) (Figure 3). For genetic diseases, the rate was highest among infants of other races (11.2 per 100,000 compared with 9.1 and 9.8 per 100,000 for whites and blacks respectively), but the rates for blacks were considerably higher among people aged 15-54 years than those for whites or for people of other races (Figure 4). The higher rates for blacks aged 15-54 years old were mainly a result of the sickle cell anemia deaths. The blacks accounted for 93% of total 5,863 sickle cell anemia deaths among people aged 15-54 years.

Overall, deaths associated with birth defects and genetic diseases were reported in about 25% of all infant deaths in the United States from 1979 through 1992. The proportion of deaths that were associated with birth defects and genetic diseases declined with the decedents' age, from about 25% among infants to about 18% among children aged 1-4, to less than 4% among adolescents and young adults aged 15-24. The proportion of female decedents who died from birth defects and genetic diseases was higher than that of males, and the proportion of whites and people of other races was higher than that of blacks (Figure 5). The proportion of all deaths that were associated with birth defects and genetic diseases remained constant by age, sex, and race/ethnicity from 1979 through 1992 (results not shown).

Table II shows the percentage distribution of deaths associated with birth defects and genetic diseases by organ system and selected categories of genetic diseases. We included both isolated and multiple birth defects. Of the 247,456 birth defect-associated deaths, 33,692 (13.6%) involved at least two listed birth defects. Cardiovascular system defects, the most commonly recorded birth defects, were mentioned in about 45.6% of death certificates. The frequency with which these defects were mentioned remained high for all age groups, with a declining trend after age 45. Nervous system and chromosomal defects were also common. Nervous system defects were mentioned in about 15% of infant deaths, and the percentage increased to about 26.8% among children aged 5-9, and declined to about 6% for people aged 45-64 years. It increased again for people aged over 65 years (11.5%). The percentage of deaths that were associated with chromosomal defects steadily increased from about 12% among infants to about 21% among people 45-64 years old. About 10% of infant deaths involved genitourinary system defects, the percentage decreased to less than 4% for people less than 35 years old and increased to more than 20% for people over 55 years old.

Hereditary neurologic disorders were reported in about 38% of deaths associated with genetic diseases. About 20.5% of deaths associated with genetic diseases involved hereditary metabolic disorders. This percentage decreased from 26% among infants to about 8% among those aged 15-34 years old, and increased again to about 29% among those aged 65 and over. Sickle cell and thalassemia were reported in about 12% of total deaths with genetic diseases. This percentage increased from about 4.4% among infants to about 19% among children aged 1-4. It peaked at age groups 25-44 (about 26%), and declined to about 6% among people who died at age 55 or over. Non-sickling hereditary blood disorders were listed in about 10% of deaths. Cystic fibrosis were reported in about 9% of genetic diseases associated deaths. This percentage increased from less than 8.6% among infants to about 35% among children aged 5-14, and declined to about 1% among those who died at age 45 or more.

Discussion

In this study, the first contemporary evaluation of deaths associated with birth defects and genetic diseases in the United States, we

observed a declining trend in the rate of birth defects associated deaths and a slightly increased trend in deaths associated with genetic diseases from 1979 to 1992. Because there have been no major changes in the overall frequency of major birth defects and genetic diseases in the last 50 years [Warkany et al., 1961; Kalter et al., 1983; Chavez et al., 1988], the declining trend in deaths associated with birth defects probably reflect 1) improvements in medical and surgical care and 2) increased use of prenatal diagnosis and subsequent pregnancy termination if selected birth defects are found 3) increased number of migration of those with fewer birth defects 4) under-reporting of deaths associated with birth defects. Other indirect evidence tends, however, to indicate that increased survival of people with birth defects played an important role. For example, the numbers and success rates of surgeries repairing heart defects and other defects have increased in recent years [Morris et al., 1991; Somerville et al., 1991; Kaplan, 1991]. There have also been several improvements in medical care of individuals with specific defects [Hein et al., 1986]. Other study indicated that among all pregnancies ascertained in which the infant or fetus had anencephaly or spina bifida, from 9% in Arkansas to 42% in Atlanta and Hawaii, were electively terminated during the period of 1985-1994 [Centers for Disease Control, 1995]. It is also likely that some nonlethal structural birth defects, for example cleft lip with or without cleft palate, especially if repaired during childhood, were not reported on death certificates. For genetic diseases, the upward trend we detected for the deaths with genetic diseases was most likely related to improved recognition of some genetic diseases rather than to the increased prevalence. For example, the study of the trends in sickle cell diseases mortality among African-Americans observed an increased age-adjusted mortality rate of 19%, from 1.7 per 100,000 African-American in 1979 to 2.0 per 100,000 in 1992 [Cono, 1996]. The study of $Alpha_1$-Antitrypsin deficiency related deaths in United States also found an upward trend from 1970 to 1991 [Browne et al., 1996].

Because more than 55% of deaths associated with birth defects occurred during the decedents: first year of life, we would expect that improved medical treatments will continue to lead to increased survival of babies with birth defects and shift mortality associated with these deaths from infancy to later stages of life. As shown by other studies [Hall et al., 1978; Epstein, 1987; Centers for Disease Control, 1989; Ling et al., 1991; Cunniff et al., 1995], birth defects contribute substantially to childhood morbidity and long-term disability and also involve high medical-care costs. The increased survival rate of people with these conditions is thus useful information for future public health planning.

Our results are consistent with the findings of other studies [Centers for Disease Control, 1986; Lynberg, 1990], which showed that birth defects were the leading cause of infant mortality, accounting for about 20% of all infant deaths. Our results further showed that a substantial percentage of deaths of older children were related to birth defects (15.5% among 1 to 4 year olds, 8% among 5 to 9 year olds, and 6% among 10 to 14 year olds). Although the percentage of deaths associated with genetic diseases was reported in less than 1% of total infant deaths, the percentages peaked among pediatric age groups (aged 1-14 years old). Overall, the deaths associated with birth defects and genetic diseases among pediatric age groups (aged 0-14 years old) were reported in about 21.5% of total number of death among pediatric age groups.

We determined that, overall, the age-adjusted mortality rates for deaths associated with birth defects and genetic diseases were higher among men than women, and among blacks than either whites or people of other ethnic groups. Among infants, blacks had the highest overall birth defects and genetic diseases reported mortality rate, resulting in the infant fraction of deaths among blacks being half that of whites and of others races (Figure 5). As suggested by other studies [Erickson, 1976; Lynberg, 1990; Hahn et al., 1991],

the higher overall mortality rates of black infants may reflect their reduced access to medical and surgical care, but they may also be related to other factors.

Cardiovascular system defects were the type of defects most commonly associated with the deaths we studied (45.6%). The improvement in medical technology is likely to increase the number and surviving time of patients with surgeries to correct heart defects [Morris et al., 1991; Somerville et al., 1991; Kaplan et al., 1991]. Therefore, we would expect an increasing number of survivors with heart defects beyond age one. The next most common group of birth defects were central nervous system defects (15%). However, with the active promotion of periconceptional multivitamin use to prevent neural tube and other defects [Mulinare et al., 1988; MRC Vitamin Study Research Group, 1991; Centers for Disease Control, 1992; Czeizel et al., 1993] and the upcoming fortification of food with folic acid [Kessler, 1996], one would expect that the birth prevalence of central nervous system defects will decline in the future. On the one hand, advances in medicine and other research in preventing birth defects and genetic diseases, if not counteracted by socioeconomic reversals or demographic forces, will increase the survival rates of people with certain types of birth defects and genetic diseases and reduce the occurrence of other types. On the other hand, as the core of uncorrectable birth defects and genetic diseases is approached, one would expect further diversity in the proportions and age distributions of deaths from birth defects and genetic diseases by organ system and selected genetic categories, as well as by comorbidities.

Our study depended on data from death certificates. In spite of many efforts to improve the quality of information on death certificates, the completeness and accuracy of information on diseases are still not ideal, especially for diseases with low case-fatality rates and deaths that occurred outside hospitals [Kuller 1995]. The studies about the validity of using death certificates in mortality analysis suggested that mortality report attained virtual completeness with expansion of death registration, but the significant problem in underreporting of fetus and newborn deaths exist in certain areas of the United States. The quality of information on death certificate tend to be high for characteristics such as age, sex and date of death, intermediate for residence, and uncertain for cause of deaths [Gittelsohn, 1978; Gittelsohn, 1982]. Other studies of birth defects using deaths certificates indicated that the birth defects were substantially underreported on death certificates [Miller, 1969; Mackeprang, 1971]. For deaths involving birth defects and genetic diseases, recording the conditions on death certificate may vary by physicians, especially when birth defects and genetic diseases were not the underlying cause of death. Because birth defects were important contributors to infant and child mortality, the under-reporting of deaths associated with birth defects were more likely to occur among adults, resulting a under-estimates of their mortality rates. The upward trend of deaths associated with genetic diseases we observed may indicate an increased recognition of some genetic diseases by physicians, such as sickle cell anemia, cystic fibrosis, and $Alpha_1$-Antitrypsin deficiency. Although imperfect, the study of deaths associated with birth defects and genetic diseases using MCMFs may provide useful information on the trends and patterns of these deaths which may be used for public health planning.

Acknowledgments

We thank Dr. Richard Olney for providing us with the categories and the list of codes of deaths that were associated with birth defects and genetic diseases.

An earlier version of this paper was presented at the 46th Annual Meeting of the American Society of Human Genetics, San Francisco, CA October 29 - November 2 1996.

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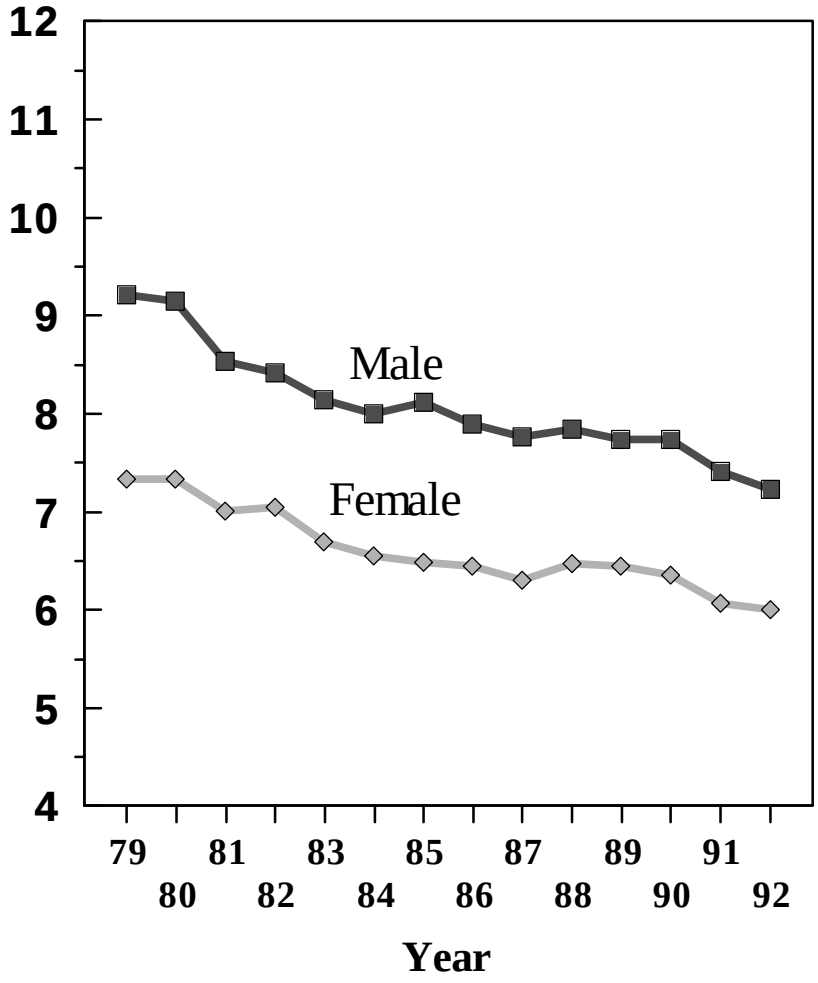
TABLE I. Categories and ICD9 Codes of Birth Defects and Genetic Diseases Included in This Study*

Conditions	ICD9
Central nervous system/eye defects	740.0 - 743.9
Cardiovascular system defects	745.0 - 747.9
Cleft palate and cleft lip	749.0 - 749.9
Gastrointestinal defects	750.0 - 751.9
Genitourinary defects	752.0 - 753.9, 654.0
Musculoskeletal & limb defects	754.0 - 755.9
Miscellaneous structural defects	228.0 - 228.1, 520.0, 520.5, 524.0, 744.0 - 744.9, 748.0 - 748.9, 745.6 - 745.7, 759.0 - 759.4, 759.7 - 759.9
Chromosomal anomalies	758.0 - 758.9
Hereditary neurocutaneous disorders	237.7, 759.5-759.6
Hereditary metabolic disorders	243.0, 255.2, 257.8, 270.0-270.8, 271.0-271.8, 272.7, 275.0-275.1 277.1-277.2, 277.4-277.6
Cystic fibrosis	277.0
Hereditary immunodeficiencies	279.2, 279.8, 288.1, 288.2
Non-sickling hereditary blood disorders	282.0-282.3, 282.7-282.8, 284.0, 286.0-286.4, 773.0, 774.0
Sickle cell disease & thalassemias	282.6, 282.4
Hereditary neurologic or storage disorders	330.0-330.1, 333.4, 334.0-334.1, 335.0, 345.6, 356.0-356.3, 359.0-359.3

*From MCMFs of NCHS.

Fig. 1. Age-adjusted mortality rates for deaths associated with birth defects, by sex and race, per 100,000 population, United States, 1979-1992



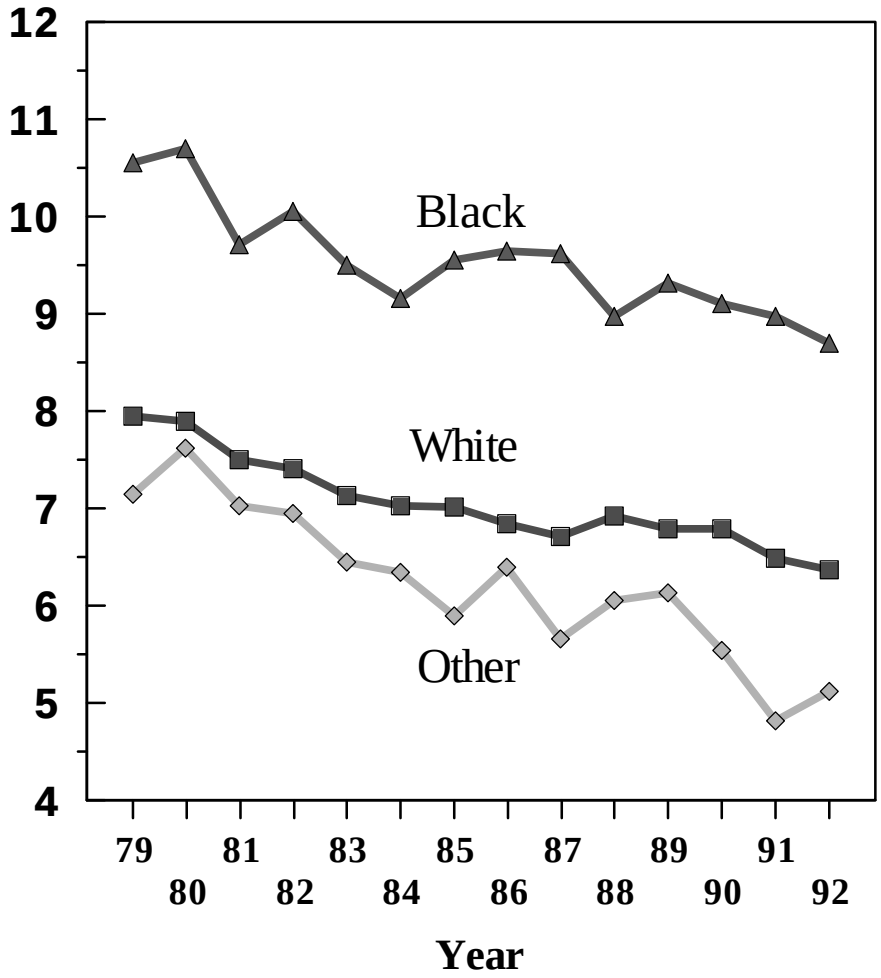


Fig. 2. Age-adjusted mortality rates for deaths associated with genetic diseases, by sex and race, per 100,000 population, United States, 1979-1992

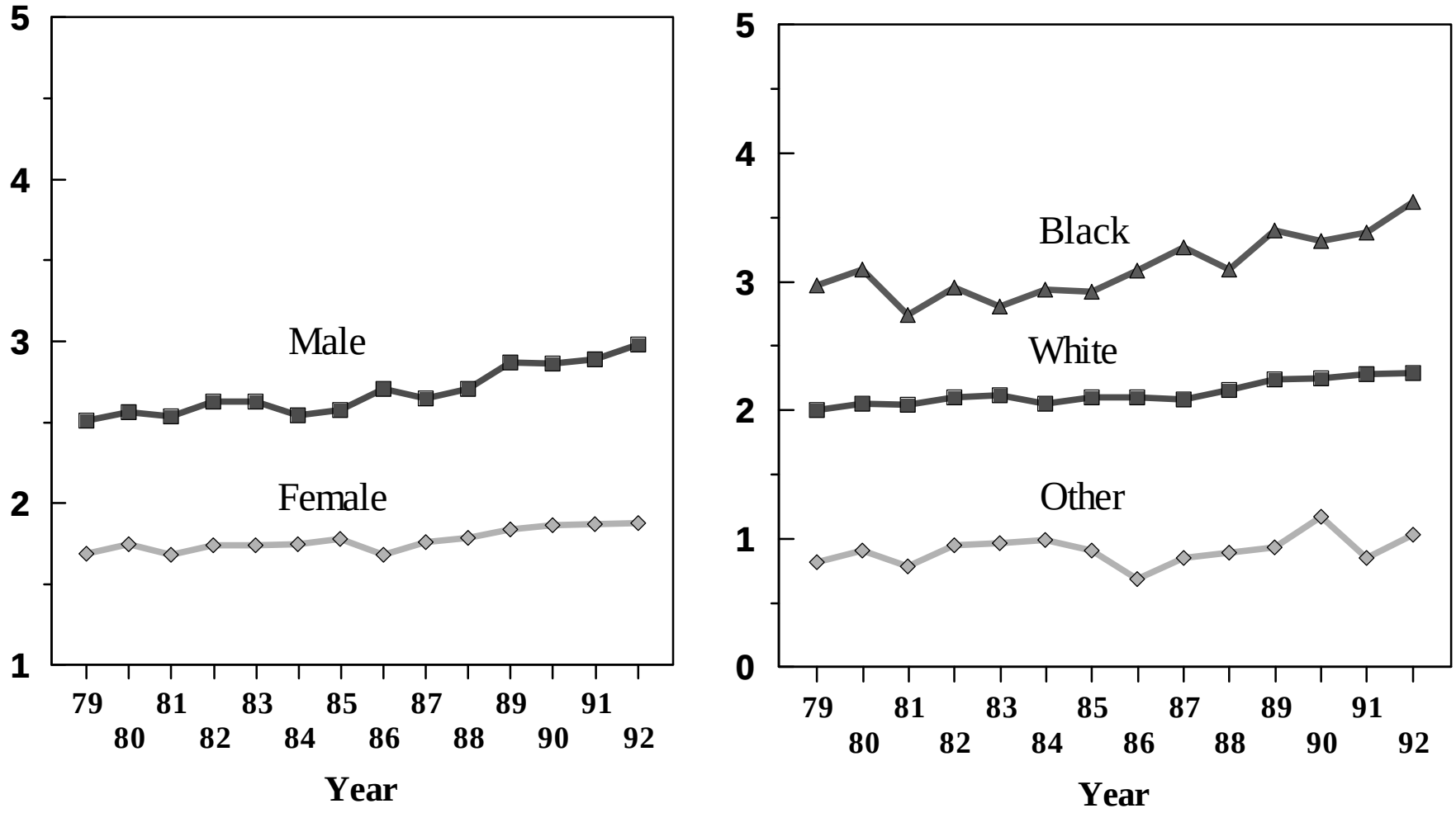
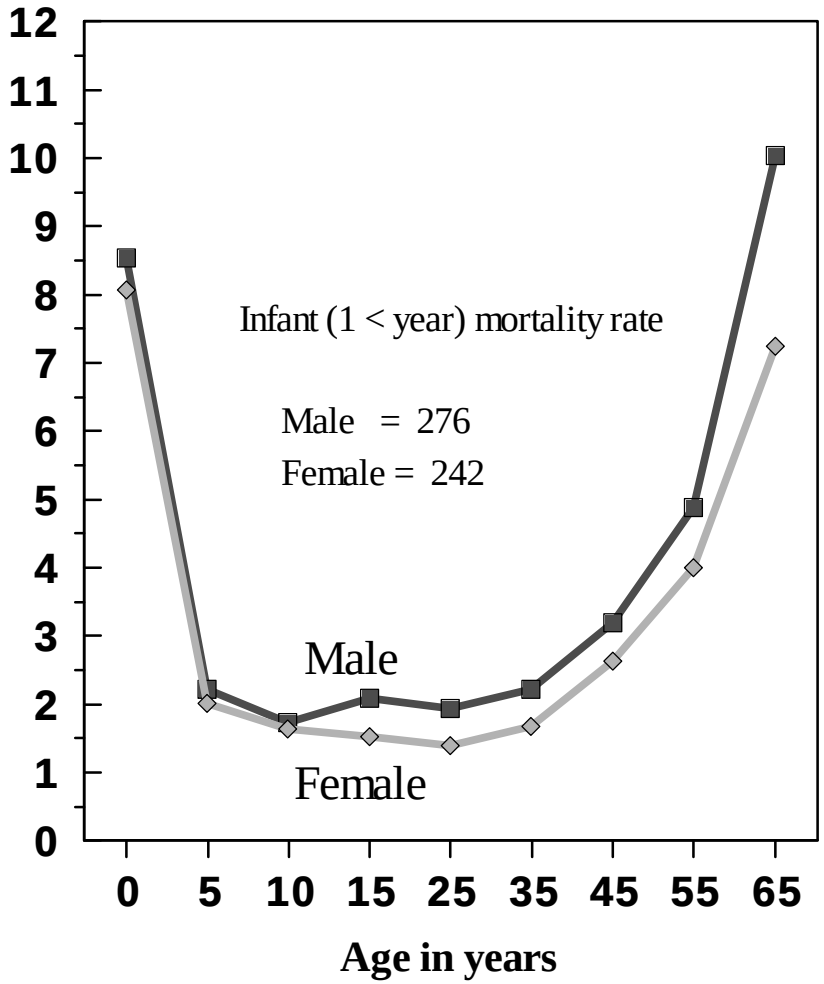


Fig. 3. Age-specific mortality rates for deaths associated with birth defects, by sex and race, United States, 1979-1992



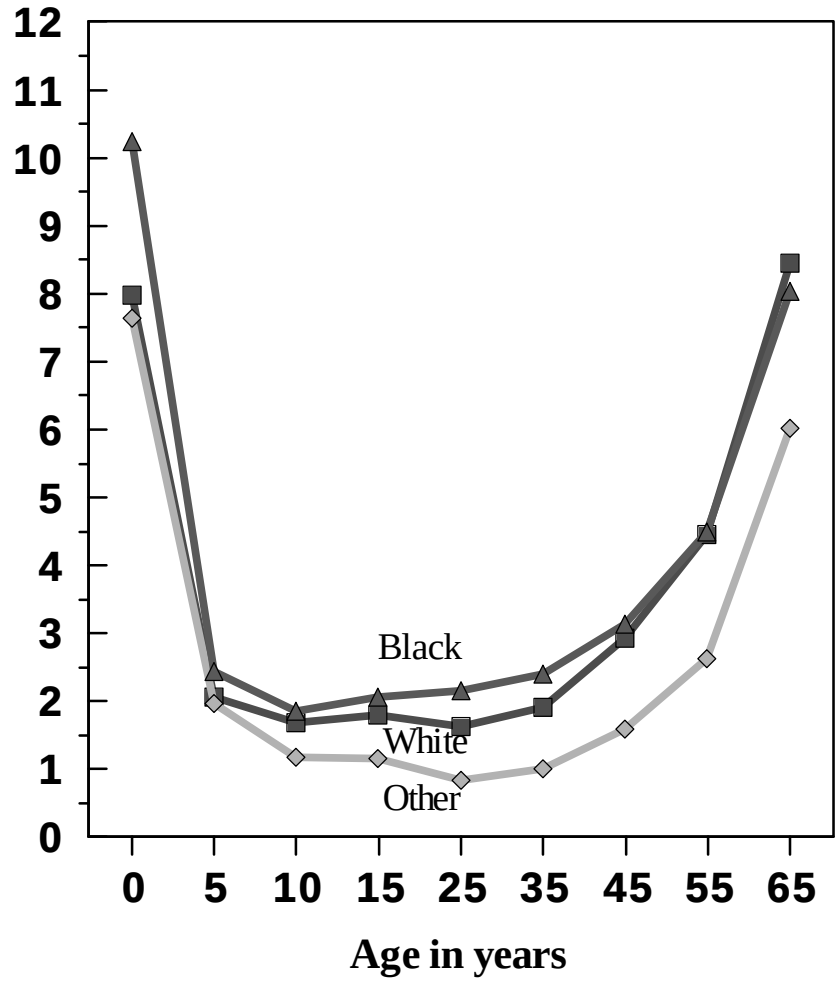


Fig. 4. Age-specific mortality rates for deaths associated with genetic diseases, by sex and race, United States, 1979-1992

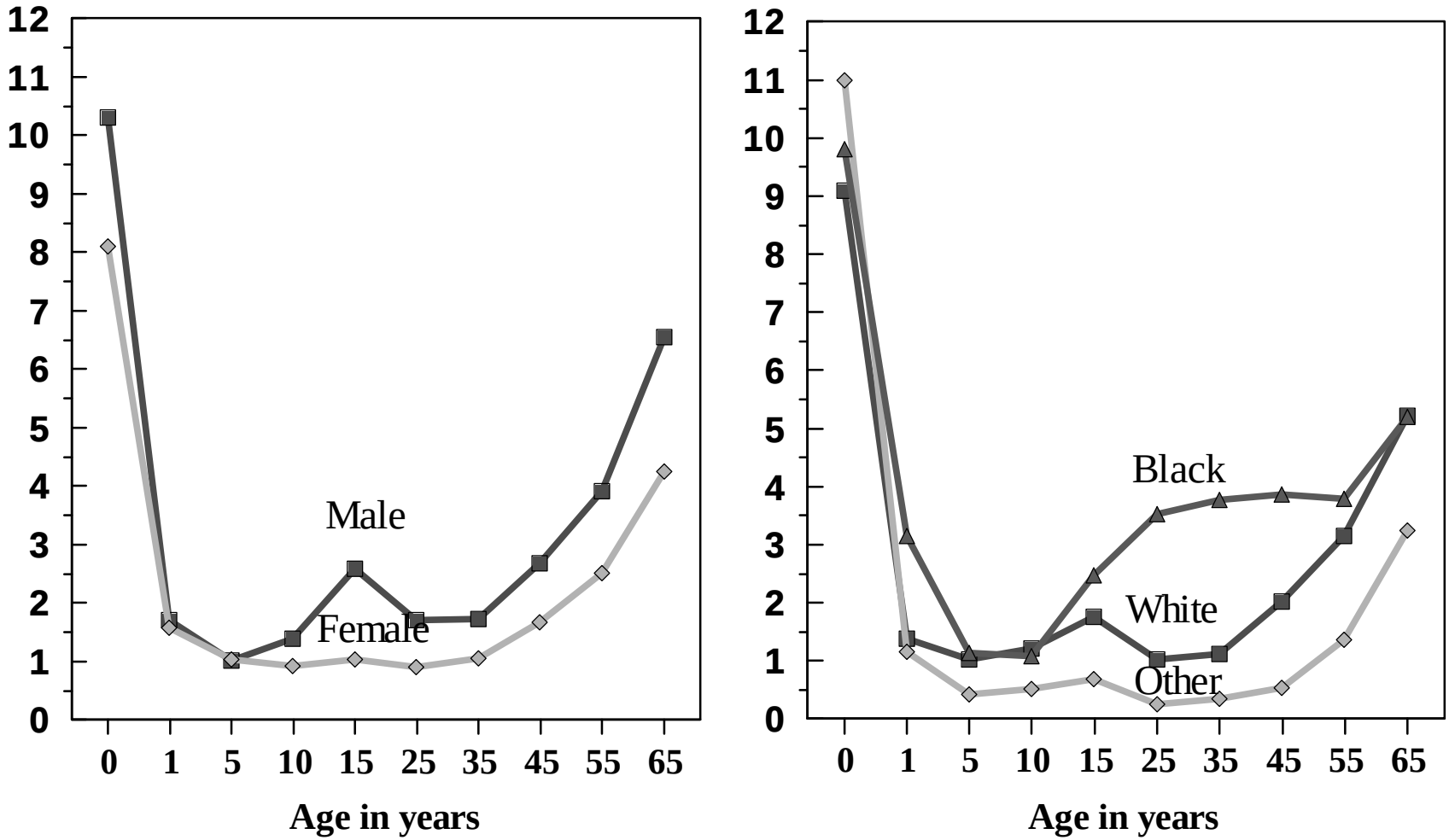


Fig. 5. Proportion of deaths that were associated with birth defects and genetic diseases, by sex and race, United States, 1979-1992

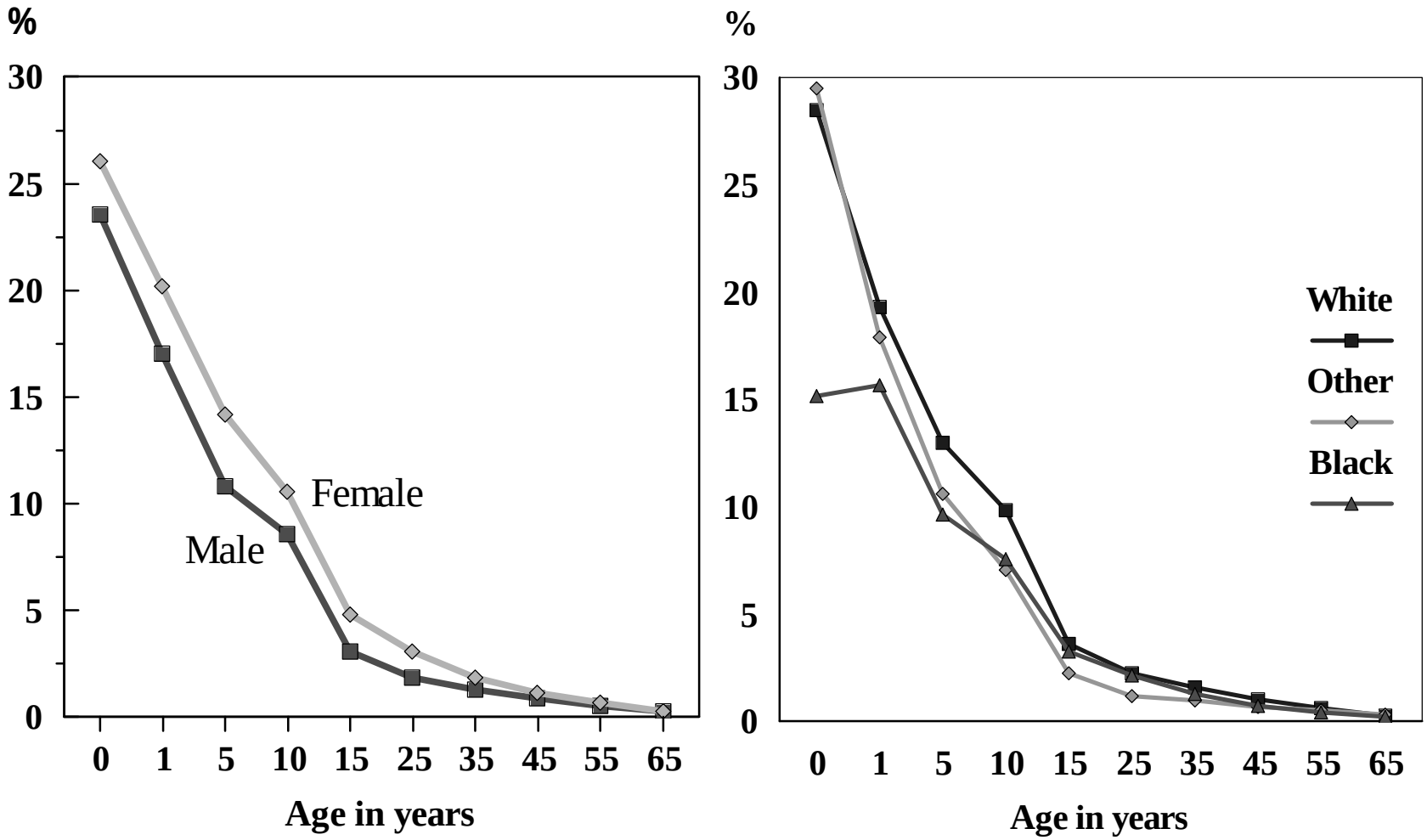


TABLE II. Percentage Distribution of Deaths Associated With Selected Birth Defects and Genetic Diseases by Age Group, United States, 1979-1992*

	Age group (years)										
	Under 1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	Total %
Birth defects											
Central nervous system	16.7	20.7	26.7	22.4	15.0	10.8	8.0	5.9	5.7	11.5	14.9
Cardiovascular system	44.7	55.4	50.1	56.7	59.0	56.7	55.6	43.5	38.0	36.5	45.6
Cleft palate and cleft lip	0.9	0.7	0.4	0.2	0.1	0.1	0.0	0.1	0.1	0.3	0.6
Gastrointestinal defetcs	3.8	5.7	3.4	1.8	1.3	1.4	1.6	2.6	3.2	8.5	4.2
Genitourinary	8.9	1.4	1.4	1.3	1.9	3.6	8.0	16.0	20.4	22.6	10.3
Musculoskeletal system	1.4	0.8	0.7	1.1	1.1	0.8	0.7	0.6	0.8	1.7	1.2
Miscell. structural defects	33.0	15.3	14.4	12.8	15.5	16.1	14.6	12.4	12.4	16.7	24.9
Chromosomal system	11.8	12.8	10.9	10.8	13.4	15.5	15.1	21.0	21.0	3.2	11.8
Birth defects total %[a]	55.3	6.6	2.1	1.7	4.1	3.9	3.5	3.9	5.4	13.6	100.0
Birth defects as % of total deaths	23.9	15.5	8.3	5.6	1.8	1.2	0.9	0.6	0.3	0.2	0.9
Genetic diseases											
Hered. neurocutaneous disorders	1.5	2.3	2.8	3.5	4.2	8.3	7.7	6.4	6.9	6.9	5.9
Hered. metabolic disorders	26.2	25.2	20.6	16.2	8.1	8.2	15.2	21.2	24.9	28.8	20.5
Cystic fibrosis	8.6	10.0	35.4	34.0	23.8	17.8	5.8	1.1	0.5	0.7	9.3
Hered. immunodeficiencies	3.4	4.3	2.1	0.8	0.6	2.1	2.6	1.5	1.7	2.6	2.1
Non-sickling hered. blood disorders	11.3	3.7	4.9	6.2	4.8	9.1	11.5	10.4	9.5	15.7	10.4
Sickle cell & thalassemias	4.4	19.2	9.0	7.1	13.5	28.0	24.1	12.5	6.2	6.4	12.1
Hered. neurologic or storage disorders	44.9	35.7	25.4	32.8	45.6	27.4	33.8	46.3	48.2	33.7	38.3
Miscellaneous hereditary disorders	0.2	0.2	0.2	0.1	0.1	0.3	0.5	1.2	2.6	5.5	2.1
Genetic diseases total %[a]	6.5	4.4	3.3	3.9	13.6	10.1	8.5	9.6	12.9	27.9	100.0
Genetic diseases as % of total deaths	0.9	3.1	4.0	3.9	1.8	1.0	0.6	0.4	0.2	0.1	0.3
Birth defects and genetic diseases total %[a]	44.1	6.1	2.3	2.2	6.2	5.2	4.6	5.2	7.1	16.9	100.0
Birth defects and genetic diseases as % of total deaths	24.6	18.4	12.2	9.3	3.5	2.2	1.5	1.0	0.6	0.3	1.1
Total birth defests and genetic diseases deaths	141,211	19,487	7,464	6,911	19,878	16,761	14,853	16,595	22,874	54,174	320,208
Total deaths	572865	105,944	61,246	73,956	564,565	765,303	988,626	1,709,911	3,850,655	20,393,910	29,086,981

*From MCMFs of NCHS.

[a] Although the total percentage distribution of birth defect and genetic disease adds up to 100% according to total number of cases, the column percentage doesn't necessarily add up to 100% because of some cases of multiple birth defects and genetic diseases. For example the percentage distribution of infant deaths associated with birth defects is about 121% indicating that a considereable percent of infants had multiple birth defects and/or genetic diseases.